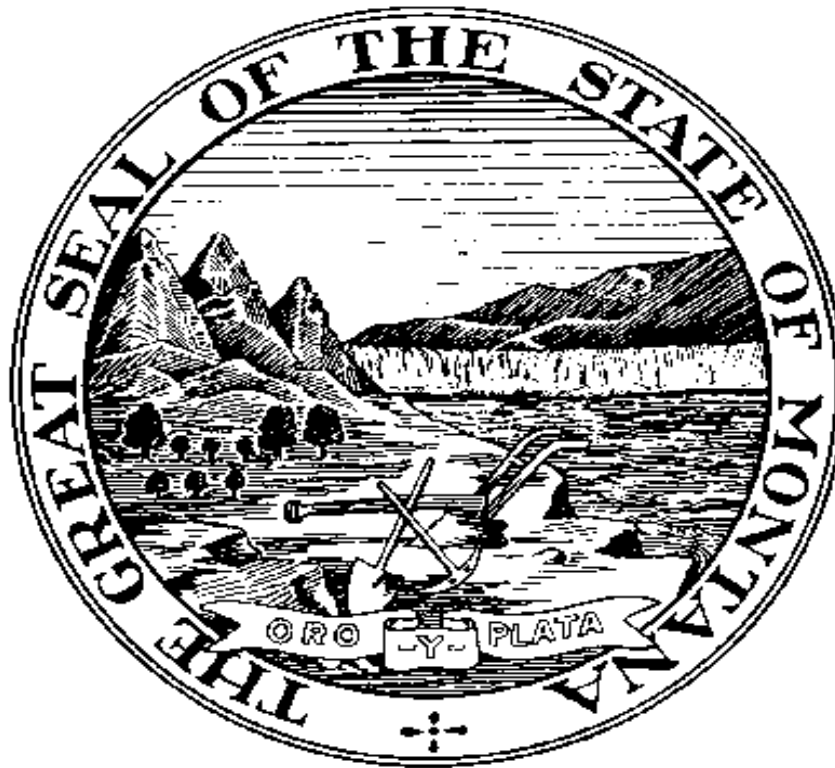


Permit Required Confined Space Entry

29 CFR 1910.146

Occupational Safety & Health Bureau



Montana Department of Labor & Industry

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by the

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Before requiring entry into a confined space answer two questions.

IS ENTRY NECESSARY?

The first thing that an employer must consider before requiring employees to enter into a confined space is if it is absolutely necessary to enter. Can the operation be performed remotely without going into the confined space? Entering into a permit required confined space is one of the most dangerous tasks that a worker can be asked to do. Employers must consider all other options before sending workers into a confined space.

CAN THE HAZARDS BE ELIMINATED?

If the confined space can be classified as permit required, the employer should try to eliminate the elements that make it permit required. The employer can do this by eliminating the hazardous atmosphere or the potential to contain a hazardous atmosphere, eliminating any material that could cause engulfment, eliminating the risk of asphyxiation and entrapment, and eliminating all other recognized serious safety and health hazards, for example, using a lockout program to control hazardous energy. If all of the hazards and potential hazards can be eliminated then the confined space can be reclassified as non-permit required.

Introduction

The hazards encountered and associated with entering and working in confined spaces are capable of causing bodily injury, illness, and death to workers. It should always be considered that the most unfavorable situation exists in every confined space and that the danger of explosion, poisoning, and asphyxiation will be present at the onset of entry. Employees lives are at stake every time there is an entry into a confined space, employers have the responsibility to protect them.

The two major factors that lead to death in confined spaces are *failure to recognize and control the hazards* associated with confined spaces, and *inadequate or incorrect emergency response*. From 1980-89 there were 585 separate fatal incidences in confined space, killing 670 victims. Over half of the victims that died in confined spaces were killed attempting rescue.

This booklet is intended to help employers understand the hazards and control methods for confined space entry. It also will provide a brief overview of the Occupational Safety and Health Administration (OSHA) standard for confined space entry 29 CFR 1910.146. This overview is not intended to be totally inclusive of the standard and does not change any of the requirements of the standard. Employers should obtain a copy of the OSHA standards and make them readily available to their employees. Free copies of OSHA standards are available from the OSHA web site (www.osha.gov).

Definitions - Please see 1910.146 (b) for a complete list of definitions.

Confined Space = A space large enough for a person to bodily enter and perform assigned work, has limited or restricted means of entry and exits, and is not designed for continuous employee occupancy.

Permit Required Confined Space = A space large enough for a person to bodily enter and perform assigned work, has limited or restricted means of entry and exits, and is not designed for continuous employee occupancy, and; contains or has the potential to contain a hazardous atmosphere; contains a material that has the potential for engulfment of the entrant; has an internal configuration such that an entrant could be trapped or asphyxiated (such as sloping walls or floors that reduce the area to a point of constriction); contains any other recognized serious safety or health hazard.

I. Confined Space Hazards

A. Atmospheric Hazards

Before forced ventilation is initiated, information such as restricted areas within the confined space, voids, the nature of the confined space present, the size of the space, the type of work to be performed, and the number of people involved should be considered.

Flammable Atmospheres

Flammable atmospheres usually arise from enriched oxygen atmospheres, vapor from flammable liquids, byproducts of work, chemical reactions, and concentrations of combustible dusts and mists. The spraying of paints and coatings on the inside of confined spaces creates a serious explosion hazard, control methods must be considered before any spraying is done. All ignition sources must be eliminated such as sparking from tools, electrical equipment, static electricity, and open flame. Local ventilation should be used when it will not interfere with the application of the paint or coating.

The ventilation air should not create an additional hazard due to recirculation of contaminants, improper arrangement of the inlet duct, or by the substitution of anything other than fresh air (approximately 20.9% oxygen). The use of forced ventilation can expand the limits of flammability and increase the hazards of fire and explosion. Many times if entry is necessary into a confined space with a flammable atmosphere the safest method to reduce the risk of explosion is to clean and eliminate all flammable liquids, vapor, and solid material (scaling) in the confined space before entry is permitted. Cleaning should be preformed by a professional team with experience in dealing with flammable materials and confined spaces. Absorbent materials can be used to remove any liquid that can not be drained from tanks.

Other flammable atmosphere problems include:

- ! Flammable gases such as acetylene, butane, propane, hydrogen, methane, natural gases or vapor from liquid hydrocarbons can be trapped in confined spaces, and since many gases are heavier than air, they will sink to the lower levels in pits, sewers, storage tanks, and vessels.
- ! In a closed top tank, lighter than air gases may rise and develop a flammable concentration if trapped above the opening.

- ! Welding in a confined space is a major cause of explosions in areas that contained combustible gas.
- ! Combustible dust concentrations are usually found during the process of loading, unloading, and conveying grain products, nitrated fertilizers, finely ground chemical products, and any other combustible material.

If any hot work is done in a confined space a hot work permit is required to be completed before work begins.

Toxic Atmospheres

Toxic gases which have been reported to cause death in workers in confined spaces include carbon monoxide (CO), hydrogen cyanide, hydrogen sulfide (H₂S), arsine, chlorine, oxides of nitrogen, and ammonia. Toxic substances can often seep into a confined space that was once considered hazard free and make it life threatening. The atmosphere of a confined space must be tested every time before a worker enters. Toxic atmospheres encountered in confined spaces may arise from the following:

- ! The manufacturing process (for example, in producing polyvinyl chloride).
- ! The product stored (removing decomposed organic material from a tank can release toxic substances, such as hydrogen sulfide).
- ! The operation performed in the confined space (for example, welding or brazing).
- ! Chemicals leaking into the confined space from the outside.

Acids used for cleaning the interior of a confined space can also produce toxic gases. For example hydrochloric acid can react chemically with iron sulfide to produce H₂S which is heavier than air and will settle out at the bottom of the confined space. H₂S is extremely toxic and can cause paralysis of the olfactory system (making the victim unable to smell the gas), loss of reasoning, respiratory failure, unconsciousness, and death.

Carbon monoxide is a hazardous gas that may build up in a confined space.

- ! CO is a colorless, odorless gas with about the same density as air.
- ! CO is formed from incomplete combustion and from microbial decomposition of organic matter in sewers, silos, and fermentation tanks.
- ! Early stages of CO intoxication are nausea and headache.
- ! CO may be fatal at 1000 ppm in air, and is considered dangerous at 200 ppm, because it forms carboxy-hemoglobin in the blood, which prevents the distribution of oxygen in the body.

A safe reading on a combustible gas meter does not ensure that CO is not present. Carbon monoxide must be tested for specifically.

Oxygen Deficiency

Consumption of Oxygen

Oxygen deficiency occurs from biological or chemical reactions that displace or consume oxygen from a confined space. Bacterial action can consume oxygen in the fermentation process and in excavations and manholes that are near landfills or moist ground.

Oxygen is also consumed during combustion of flammable substances, in welding, cutting, and brazing. Chemical reactions can consume oxygen, for example in the formation of rust on exposed surfaces of metal tanks and vats. Oxygen consumption is also influenced by the number of people working in a confined space and the amount of physical activity.

Displacement of Oxygen: Inert Gas and Asphyxiants

In sufficient quantity an inert gas or asphyxiant will displace oxygen and may result in an atmosphere unable to support normal respiration. Inert gas is used to reduce the oxygen level (oxygen is necessary to support a fire or explosion) in confined spaces that contain flammable liquid or vapors. Helium, argon, and nitrogen are the most used gases for inerting confined spaces. The normal atmosphere consists of 21% oxygen, 78% nitrogen, and 1% argon with small amounts of other gases. For example, if 100% argon (a non-toxic gas) is used to inert (displace oxygen) in a confined space, it will cause immediate collapse and death to the worker if the confined space is not adequately ventilated before entry. Carbon dioxide can occur naturally in sewers, storage bins, wells, tunnels, wine vats, and grain elevators, and can also displace air.

Decreased oxygen levels below the normal 20.9% can cause various effects including:

- ! less than 17%: partial loss of night vision, increased breathing and heartbeat;
- ! between 14-16 %: increased breathing volume, accelerated heartbeat, poor muscular coordination, rapid fatigue, and intermittent respiration;
- ! between 6-10%: nausea, inability to perform, vomiting, and unconsciousness; and
- ! less than 6%: spasmodic breathing, convulsions, and death in minutes.

Solvents

Solvents used to degrease and clean can also harm or kill entrants of a confined space. Hydrocarbon solvents can depress the central nervous system (CNS) and cause unconsciousness. Certain chlorinated or fluorinated hydrocarbon solvents are toxic to the heart and have been associated with sudden death in confined spaces. Methylene chloride can metabolize in the body to create carbon monoxide and produce a "Adrunken" state.

B. Physical Hazards

Physical hazards associated with confined space include: mechanical, electrical, and hydraulic energy; engulfment; communication problems; noise; and size of openings in a confined space.

Hazardous Energy

If activation of electrical or mechanical equipment would cause injury, each piece of equipment should be manually isolated to prevent activation before workers enter or while they are working in a confined space. An effective lockout/tagout program must be used when a worker enters a confined space with an energy release hazard (see 29 CFR 1910.147).

Engulfment

Engulfment in loose materials is one of the leading causes of death from physical hazards in confined spaces. Engulfment and suffocation hazards are associated with storage bins, silos, and hoppers where grain, sand, gravel, or other loose materials are stored, handled, or transferred.* Workers can become entrapped or buried in a matter of seconds.

Communication Problems

Communication between the worker inside the confined space and the standby attendant outside is of the utmost importance. When visual monitoring of the worker is not possible because of design of the confined space or location of the entry hatch, a voice or alarm-activated explosion proof type of communication will be necessary. Lighting can also prevent visibility problems in confined spaces.

Other Hazards

Other hazards of confined space entry include:

- ! Falling objects from topside openings in the confined space;
- ! Thermal effects, extremely hot or cold temperatures can make work inside a confined space hazardous;
- ! Wet or slick surfaces can cause falls in the confined space, as well as grounding paths for electricity;
- ! Noise levels can be amplified inside the confined space causing hearing damage and communication problems;
- ! The size of openings into the confined space can present problems with personal protective equipment (PPE) and escape from the confined space; and
- ! The use of scaffolding in a confined space also creates problems.

II. Permit Required Confined Space Entry Requirements

A. Employer Requirements

- ! Determine the presence of a confined space in the workplace.
- ! Determine if any identified confined spaces meet the definition of a permit required confined space".
- ! Inform all exposed employees of the existence of the permit required confined spaces by posting appropriate danger signs or by an equally effective means.
- ! Decide if any type of entry will be permitted into the permit required confined space. If no entry is allowed, the space must be effectively secured against employee entry. If entry will occur only by an outside contractor and his personnel, then the employer is the "host" and is responsible for providing the contractor or other employer with all available information regarding the hazards present in the permit required confined space including applicable safety and rescue procedures.
- ! If an employer is going to use his/her own employees to accomplish entry into any permit required confined space, whether he/she is the owner of the facility or the employer of personnel contracted to do work in a permit required confined space (PRCS), that employer must establish and implement an entry permit program.
- ! Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed. When entrance covers are removed the opening must be guarded by a railing or temporary cover.

B. ENTRY PERMIT PROGRAM BASIC ELEMENTS

- ! Prevent unauthorized entry,
- ! Identify and evaluate hazards prior to entry,
- ! Develop and implement the means, procedures and practices necessary for safe entry into PRCS or a Written Permit System.
- ! Information that is required on each permit:
 - *Name and location of space;
 - *purpose of the entry;
 - *date and duration of the permit,
 - *list of authorized entrants;
 - *name of current attendants and entry supervisor;
 - *list of hazards in the space;
 - *list of measures to isolate the space & to eliminate or control the hazards;
 - *acceptable entry conditions regarding hazards;
 - *results of tests & initials of person performing them;

- *rescue and emergency service available and means to summon them;
- *communication procedures for entrants and attendants;
- *any required equipment e.g., respirators, communicators, alarms, etc; and
- *any additional permits e.g., hot work.

- ! Ensure that any and all necessary equipment is available for safe entry, egress, and rescue,
- ! Protect entrants from external hazards,
- ! Evaluate conditions prior to entry and during the course of the entry,
- ! Designate and train personnel who have active roles,
- ! Rescue, develop and implement procedures,
- ! Entry coordination between multi-employer personnel,
- ! Review the program and permits.

C. WRITTEN ENTRY PERMIT SYSTEM:

The Entry Permit must be completed before entry is authorized, this is the first requirement of the permit system.

Before entry begins, the designated entry supervisor must sign the permit authorizing the entry.

The written authorized permit must be posted at/near the space entrance, to allow entrants to confirm that preparations are complete.

The permit is good only for the time required to complete the task or assignment spelled out in the permit.

The entry supervisor must terminate and cancel the permit when the task is completed or when a condition is found not covered in the permit.

Canceled permits must be kept for one year to allow annual review and to facilitate program improvements.

D. TRAINING

Training must be tailored to specific employee needs and operations, but must at least include:

- ! Recognition and identification of confined spaces and permit confined spaces;
- ! Confined space entrant, attendant, and supervisor procedures;
- ! Communications between workers inside and standby;
- ! Rescue procedures;
- ! The hazards involved with entry into a confined space (fire, explosion, asphyxiates, oxygen deficiency, engulfment, toxic atmospheres, mechanical hazards, etc.);

- ! Respirator use and program (1910.134);
- ! The use of personal protective equipment inside a confined space; and
- ! Monitoring procedures.

Employees need to be trained:

- ! before duties are assigned and if they are changed;
- ! whenever there is a change in operations affecting the PRCS program; and
- ! whenever the employer has reason to believe there are deviations from or deficiencies in the PRCS program.

Written certification of training is required, listing employee name, date of training, and the signature or initials of the trainer. Such certification must be made available by the employer.

E. Duties

Entrant Duties

- (1) Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;
- (2) Properly use equipment as required;
- (3) Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space as required;
- (4) Alert the attendant whenever:
 - ! The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or
 - ! The entrant detects a prohibited condition; and
- (5) Exit from the permit space as quickly as possible whenever:
 - ! An order to evacuate is given by the attendant or the entry supervisor.
 - ! The entrant recognizes any warning sign or symptom of exposure to a dangerous situation.
 - ! The entrant detects a prohibited condition.
 - ! An evacuation alarm is activated.

Attendant Duties

- (1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;
- (2) Be aware of possible behavioral effects of hazard exposure in authorized entrants;
- (3) Continuously maintains an accurate count of authorized entrants in the permit space and ensure that the means used to identify authorized entrants accurately identifies who is in the permit space;
- (4) Remains outside the permit space during entrant operations until relieved by another attendant;

NOTE: When the employer's permit entry program allows attendant entry for rescue, attendants may enter a permit space to attempt a rescue **only** if they have been trained and equipped for rescue operations as required.

- (5) Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space;
- (6) Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions:
 - ! If the attendant detects a prohibited condition;
 - ! If the attendant detects the behavioral effects of hazard exposure in an authorized entrant;
 - ! If the attendant detects a situation outside the space that could endanger the authorized entrants;
 - or
 - ! If the attendant cannot effectively and safely perform all the duties required.
- (7) Summons rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards;
- (8) Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:
 - ! Warn the unauthorized persons that they must stay away from the permit space;
 - ! Advise the unauthorized persons that they must exit immediately if they have entered the permit space; and
 - ! Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space;
- (9) Performs non-entry rescues as specified by the employer's rescue procedure; and
- (10) Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

Supervisor Duties

- (1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;
- (2) Verifies, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin;
- (3) Terminates the entry and cancels the permit as required;
- (4) Verifies that rescue services are available and that the means for summoning them are operable;
- (5) Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations; and
- (6) Determines, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

F. RESCUE AND EMERGENCY SERVICES:

Each employer whose employees enter permit required confined spaces to perform rescue services must:

- ! Ensure that each member of the rescue service is provided with, and is trained to use properly, the personal protective equipment and rescue equipment necessary for making rescues from permit spaces.
- ! Assign duties to each member of the rescue service and ensure they are properly trained to perform the assigned rescue duties. Each member of the rescue service must also receive the training required of authorized entrants.
- ! Ensure that members of the rescue service practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces that accurately simulate the types of permit spaces from which rescue is to be performed.
- ! Ensure that each member of the rescue service is trained in basic first-aid and in cardiopulmonary resuscitation (CPR). At least one member of the rescue service must hold current certification in first aid and in CPR.
- ! A host employer must inform contracted rescue services of the hazards they may confront when called on to perform rescue, and provide the rescue service with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations. Response time must also be considered in selecting an outside rescue team, if rescue does not occur in within four minutes the victim could have brain damage .
- ! If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or

other similar written information is required to be kept at the worksite, that MSDS or written information must be made available to the medical facility treating the exposed entrant.

G. Testing the Atmosphere:

Authorized permit space entrants must be provided the opportunity to observe any testing or monitoring of the permit space. This will give the entrants the information necessary to protect themselves and their co-workers from confined space hazards. It will also help to ensure that the testing has been done properly, that the respirators and other personal protective equipment being worn are appropriate, and that the entrants understand the nature of the hazards present in the space.

Employees with the responsibility of atmospheric testing need to be trained in:

- ! Proper use of the equipment;
- ! Knowledge of the calibration of equipment;
- ! Knowledge of sampling strategies and techniques; and
- ! Knowledge of Permissible Exposure Limits (PELs), Threshold Limit Values (TLVs), Lower Explosive Limits (LELs), Upper Explosive Limits (UELs), etc;

Testing Procedures

- ! Test oxygen level first, then combustible vapors, and then toxic gases and vapors;
- ! Test all areas of the confined space (top, middle, bottom); and
- ! Never trust your senses alone.

H. Space Reclassification

A space classified by the employer as a permit-required confined space may be reclassified as a non-permit confined space under the following procedures:

- ! If the permit confined space poses no actual or potential atmospheric hazards and if hazards within the space are eliminated without entry into the space, the permit space may be reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.
- ! If it is necessary to enter the permit space to eliminate hazards, such entry must be performed as for a permit-required confined space. If testing and inspection during that entry demonstrate that the hazards within the permit space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.

NOTE: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. Paragraph (c)(5) of the standard (Alternate Entry) cover permit space entry where the employer can demonstrate that forced air ventilation alone will control all hazards in the space.

- ! The employer must document the basis for determining that all hazards in a permit space have been eliminated, through a certification that contains the date, the location of the space, and the signature of the person making the determination. The certification must be made available to each employee entering the space.
- ! If hazards arise within a permit space that has been declassified to a non-permit space, each employee in the space must exit the space immediately. The employer must then reevaluate the space and determine whether it must be reclassified as a permit space. It is good practice to monitor every confined space, permit required or not, before every entry is made.

I. ALTERNATE ENTRY

Alternate Entry Conditions

If specific conditions are met, an employers employees may enter a permit required confined space under alternate procedures without complying with certain paragraphs of the standard. Those conditions are;

- ! The employer must demonstrate, through monitoring and inspection data, that the only hazard posed by the permit space is an actual or potential hazardous atmosphere;
- ! The employer must demonstrate, again through monitoring and inspection data, that continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry;
- ! The determinations and supporting data required are documented by the employer and are made available to each employee who enters the permit space; and
- ! Initial entry into the permit space to obtain the data required is performed in accordance with a permit required confined space program, and subsequent entry into the permit space is performed in accordance with the requirements of the standard as outlined below.

Alternate Entry Procedures

- Any conditions making it unsafe to remove an entrance cover must be eliminated before the cover is removed.
- When entrance covers are removed, the opening must be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.
- Before an employee enters the space, the internal atmosphere must be tested, with a calibrated direct-reading instrument, for the following conditions in the order given- oxygen content, flammable gases and vapors, and potential toxic air contaminants.
- ! There may be no hazardous atmosphere within the space whenever any employee is inside the space.

! Continuous forced air ventilation must be used, as follows:

*An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere;

*The forced air ventilation must be so directed as to ventilate the immediate areas where an employee is or will be present within the space and must continue until all employees have left the space;

*The air supply for the forced air ventilation must be from a clean source and may not increase the hazards in the space.

! The atmosphere within the space must be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of hazardous atmosphere.

! If a hazardous atmosphere is detected during entry:

*Each employee must leave the space immediately;

*The space must be evaluated to determine how the hazardous atmosphere developed; and

*Measures must be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

! The employer must verify that the space is safe for entry and that the pre-entry measures required have been taken, through a written certification that contains the date, the location of the space, and the signature of the person providing certification. The certification must be made before entry and must be made available to each employee entering the space.

When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, the employer must reevaluate that space and, if necessary, reclassify it as permit-required confined space.

J. Confined Space Entry Permits

It is important to note that the permits required under the standard must contain certain information, apply only for the duration of the current task, and must be retained for one year. Permits can be developed by the employers but must cover all of the required items. Items covered on confined space entry permits must include:

! Identification of the space;

! The purpose of the entry;

! The date and duration of the permit;

- ! A list of authorized entrants;
- ! Names of current attendants and the entry supervisor;
- ! A list of hazards in the permit space;
- ! A list of measures to isolate the permit space and eliminate or control the hazards;
- ! The acceptable entry conditions;
- ! The results of tests initiated by the person(s) performing the tests;
- ! The rescue and emergency services available and the means to summon them;
- ! Communications procedures for attendants and entrants;
- ! Any required equipment (such as respirators, communications, alarms, etc); and
- ! Any other necessary information; and any additional permits (such as for hot work).

III. Confined Space Deaths

Case 1. Confined Space Entry*

An employee of a zinc refinery was working in a zinc dust condenser when he collapsed. Another employee donned a self-contained breathing apparatus (SCBA) and attempted to enter the condenser and rescue the downed employee. He was not able to fit through the portal wearing the SCBA, so he removed it, handed it to another employee, and then entered the condenser. He planned to have the other employee hand the SCBA to him through the portal, re-don it, and then continue with the rescue. He collapsed and fell into the condenser before he could re-don the SCBA. The first employee was declared dead at the scene; the would-be rescuer died two days later. The toxic air contaminant was later determined to be carbon monoxide.

Case 2. Hydrogen Sulfide Poisoning*

A maintenance worker entered a sewer manhole to repair a pipe and collapsed at the bottom. A co-worker, who had been observing the initial entrant, entered the manhole, lost consciousness, and fell to the bottom. A supervisor looked into the manhole, saw the would-be rescuer, and entered to attempt rescue. The supervisor became dizzy, climbed from the manhole, and passed out. When he regained consciousness, the supervisor summoned rescue and emergency services. Both the initial entrant and the first would-be rescuer died of hydrogen sulfide poisoning.

Case 3. Tractor-Trailer Repairman Dies from an Explosion Inside a Tanker*

A 34-year old welder, with 15 years experience, working for a trailer repair company entered an 8500 gallon cargo tank to weld a leak on the interior wall of the tanker. The tanker was a multi-compartment type with four compartments of different sizes with a leak in an interior wall that required welding. The tanker was not properly cleaned and flammable vapors remained inside of the tanker. Before starting work the welder's assistant noticed the presence of "A strong fumes" but the welder ignored the warning. When the welder began his weld there was an explosion inside of the tank, killing him. The autopsy report listed the cause of death as "Multiple blunt force injuries."

Case 4. Worker Dies in Fermentation Tank in Montana*

A 35-year old worker was hosing down the interior (from the outside top opening) of a fermentation tank when the accident occurred. For some unknown reason, the worker entered the tank and was confronted with an atmosphere of 6 % oxygen and 48% carbon dioxide (CO₂). The victim had been on the job for approximately 3 weeks, and had received on-the-job training only. The only training received regarding confined space was a warning not to enter the tanks because of the CO₂ hazard.

It is believed the worker's hat fell into the tank and he was attempting to retrieve it when the fatal accident occurred. The tank agitator had been turned off, which meant the victim had gone over to the control room to turn off the motor before attempting to remove the hat. It is believed the victim leaned in through the top of the opening, head first, and fell through the opening and struck his head on one of the agitator blades.

The foreman heard the thrashing/thumping noise from inside the tank and came out of the dehydration room to check it out. He looked around and found the victim trying to get out of the tank. Unable to reach the victim, he secured a rope and looped it around the victim's arm; however, he was still unable to pull the victim out of the tank. The foreman then called a rescue squad. It was approximately 2 hours from the time the victim was discovered until his removal from the tank. The victim was dead when finally removed.

Conclusion

Confined spaces are a factor in many occupational deaths every year. Workers are killed, families are torn apart, and children left without a father/mother, because the proper safety procedures are not taken. Hazards must be identified and proper control measures in place, and most importantly workers and rescuers thoroughly trained before any entry into a confined space is allowed. Even if a worker has entered a confined space 100 times without incident the next time could be the last. Take proper procedures every time an entry is made.

Sample permit and pre-entry checklist provided in the appendices are for examples only employers must develop their own which is specific to their worksite. The OSHA standards also contain examples, please see the resources section of the booklet for details on where to get copies of the standards.

Resources

Additional information about occupational safety and health standards and regulations can be obtained from:

1. U.S. Department of Labor, **Occupational Safety & Health Administration, (OSHA).**

Public Affairs Office- Room 3647

200 Constitution Ave.

Ashington, D. C. 20210

Phone # (202) 693-1999

Web Site: www.osha.gov

2. **National Institute for Occupational Safety and Health, (NIOSH).**

Department of Health and Human Services

200 Independence Ave. SW 317B

Washington, D. C. 20201

Phone # 1-800- 356-4674, 1-800-35-NIOSH

Web Site: www.niosh.gov

3. **American Conference Of Governmental Industrial Hygienists, (ACGIH).**

1330 Kemper Meadow Drive

Cincinnati, OH 45240-1634

Phone # (513) 742-2020, Fax: (513) 742-3355

Web Site: www.acgih.org

4. **National Fire Protection Association, (NFPA).**

P.O. Box 9101

One Batterymarch Park

Quincy, MA 02269-9101

Phone # 1-800-344-3555, Fax: (617)-770-0700

Web Site: www.nfpa.org

5. **National Safety Council.**

1121 Spring Lake Drive

Itasca, IL 60143-3201

Phone # (630) 285-1121, Fax: (630) 285-1315

Web Site: www.nsc.org

6. **Department of Energy, (DOE).**

Forrestal Building

1000 Independence Ave. SW

Washington, D.C. 20585

Web Site: www.doe.gov

**Worker Deaths In Confined Spaces. A Summary of NIOSH Surveillance and Investigative Findings. NIOSH. January 1994*

State Occupational Safety and Health Consultation Project

A source of assistance with construction and general industry safety and health is the Montana Onsite Consultation Project. This division of the Department of Labor and Industry operates independently of OSHA's enforcement branch. The program was developed with small businesses in mind, and is available to private sector employers who want help in recognizing and correcting jobsite hazards.

When an employer uses the service, a trained occupational safety and health professional conducts a free onsite "inspection" and consultation. No citations or penalties are given for any of the problems that the inspector/consultant may find, and the service is completely confidential. The employer has the responsibility and obligation through the program to correct the identified hazards within an allotted amount of time. In addition, the consultant can assist in developing and maintaining an effective safety program, offer jobsite training and education for employees, and help locate other sources of assistance for safety and health concerns.

Although this program can be beneficial, you must realize that there is still no guarantee that a jobsite that has received the consultation services will pass an OSHA inspection. For information about Montana's Onsite Consultation Project please contact:

Safety & Health Bureau
Department of Labor and Industry
P.O. Box 1728
Helena, MT 59624-1728
(406) 444-6401

Appendix 1. Pre-Entry Checklist

Confined Space Pre-Entry Check List

A checklist must be filled out whenever workers enter a permit required space. A copy of the safe entry procedure and a pre-entry checklist must be available at the entry point to the confined space. This is an example of a general checklist, employers should develop a checklist for each different permit space or type of hazard.

		Yes	No
1.	Did your survey of the surrounding area show it to be free of hazards such as drifting vapors from tanks, piping or sewers?	<input type="checkbox"/>	<input type="checkbox"/>
2.	Does your knowledge of industrial or other discharges indicate this area will remain free of dangerous air contaminants while occupied?	<input type="checkbox"/>	<input type="checkbox"/>
3.	Are you certified in operation of the gas monitor to be used?	<input type="checkbox"/>	<input type="checkbox"/>
4.	Has a gas monitor functional test (Bump Test) been performed this shift on the gas monitor to be used?	<input type="checkbox"/>	<input type="checkbox"/>
5.	Did you test the atmosphere of the confined space prior to entry?	<input type="checkbox"/>	<input type="checkbox"/>
	(a) Was oxygen content between 19.5 % and 23.5 % ?	<input type="checkbox"/>	<input type="checkbox"/>
	(b) Was flammable vapor less than 10 % of LEL/LFL ?	<input type="checkbox"/>	<input type="checkbox"/>
	(c) Were tests for toxic materials less than TLV/PEL?	<input type="checkbox"/>	<input type="checkbox"/>
6.	Have all sources of hazards been isolated from the confined space?	<input type="checkbox"/>	<input type="checkbox"/>
	(a) Have all pipes been blanked (sealed)?	<input type="checkbox"/>	<input type="checkbox"/>
	(b) Have electrical and mechanical hazards been locked and blocked?	<input type="checkbox"/>	<input type="checkbox"/>
7.	Will the atmosphere be continuously monitored while the space is occupied?	<input type="checkbox"/>	<input type="checkbox"/>
8.	Is all rescue equipment called out in the entry procedure available outside the confined space?	<input type="checkbox"/>	<input type="checkbox"/>
9.	Have the facility emergency and rescue services been notified about the entry?	<input type="checkbox"/>	<input type="checkbox"/>

NOTICE: If any of the above questions are answered "No" do not enter. Contact your immediate supervisor.

Job Location _____
 Lead Man Signature _____ Date _____

Appendix 2. Confined Space Entry Permit

Confined Space Entry Permit (post at entrance)

PERMIT# _____

Permit valid for 8 hours only. All permit copies remain at site until job is completed.

Date & Time Issued: _____ Date & Time: _____
Expires: _____ Job site/Space I.D.: _____
Job Supervisor: _____ (PRINT NAME) _____ Equipment to be worked on: _____
Purpose of Entry: _____

Communications Procedures: _____

Rescue Procedures: _____

Authorized Entrants: (PRINT NAME) _____ (SIGNATURE) _____

Stand-by Personnel: _____

Existing Hazards & Controls : Fire/Explosion: _____

Hazardous Energy: _____

Atmospheric: _____

Engulfment/Entrapment: _____

Other: (fall, noise, etc.) _____

Additional Work Permits: _____

BOLD DENOTES MINIMUM REQUIREMENTS TO BE COMPLETED AND REVIEWED PRIOR TO ENTRY

REQUIREMENTS COMPLETED	DATE	TIME	REQUIREMENTS COMPLETED	DATE	TIME
Lock Out/De-energize/Try-out	_____	_____	Full body Harness w/≡D≡ ring	_____	_____
Line(s) Broken-Capped-Blank	_____	_____	Emergency Escape Retrieval Equip.	_____	_____
Purge-Flush and Vent	_____	_____	Lifelines	_____	_____
Ventilation	_____	_____	Fire Extinguishers	_____	_____
Secure Area (Post and Flag)	_____	_____	Lighting (Explosive Proof)	_____	_____
Breathing Apparatus	_____	_____	Protective Clothing	_____	_____
Resuscitator - Inhalator	_____	_____	Respirator(s) (Air Purifying)	_____	_____
Standby Safety Personnel	_____	_____	Burning and Welding Permit	_____	_____

NOTE: ITEMS THAT DO NOT APPLY ENTER N/A IN THE BLANK.

RECORD CONTINUOUS MONITORING RESULTS EVERY 2 HOURS

Continuous Monitoring	Permissible	Pre-Entry	1	2	3	4
Test(s) to be taken	Entry					
Percent of Oxygen	19.5% to 23.5%	_____	_____	_____	_____	_____
Lower Flammable	Limit Under 10%	_____	_____	_____	_____	_____
Carbon Monoxide	+35 PPM	_____	_____	_____	_____	_____
Aromatic Hydrocarbon	+1PPM *5PPM	_____	_____	_____	_____	_____
Hydrogen Cyanide	(Skin) *4PPM	_____	_____	_____	_____	_____
Hydrogen Sulfide	+10PPM *15PPM	_____	_____	_____	_____	_____
Sulfur Dioxide	+ 2PPM * 5PPM	_____	_____	_____	_____	_____
Ammonia	*35PPM	_____	_____	_____	_____	_____

*Short-term exposure limit: Employee can work in the area up to 15 minutes.

+8 hour Time Weighted Avg: Employee can work in area 8 hrs (longer with appropriate respiratory protection.)

Person Performing Tests: _____

GAS TESTER NAME & CHECK # _____ INSTRUMENT(S) USED _____ MODEL /SERIAL # _____

Supervisor Authorization - All conditions satisfied :

Emergency Numbers Safety: _____ Gas Coordn.: _____ Ambulance: _____ Fire: _____

Appendix 3.

Hot Work Permit

Date: _____ Location: _____
Reason for entry: _____
Authorized duration: _____ Type of Hot Work: _____

HOT WORK HAZARDS: In addition to the hazards listed on the entry permit, hot work can result in:

____ Oxygen deficiency/enrichment ____ Fire/explosion; specify _____
____ Toxin releases; specify _____
____ Engulfment/Entrapment _____
____ Hot/corrosive materials; specify _____
____ Other; specify _____

HOT WORK PROCEDURES: In addition to the procedures listed on the entry permit, required hot work procedures include:

____ Vessel Preparation, including: ____ Cleaning ____ Flushing
____ Surface wet down ____ Ventilation Purge - Time: _____
____ Special isolation procedures, including: _____

Other _____

REQUIRED EQUIPMENT: In addition to the equipment listed on the entry permit, hot work will require:

____ Ventilators - min. cap. ____ CFM; ____ Respirators-type: _____
____ Atmospheric monitors - type: _____
____ Communication - type: _____

Personal Protective Equipment:

____ Eye, ____ Hearing, ____ Foot, ____ Hand, ____ Other: _____;
____ Sparkproof Tools; ____ Lighting
____ Rescue/Emergency Equipment: ____ SCBA; ____ Fire Extinguisher-Type ____
____ First Aid kit; ____ Other - _____

SPECIAL WORK PROCEDURES:

- Tools inspected for frayed, broken wires.
- Never bring cylinders or other large equipment into space.
- No Smoking.
- Never block entry/exits with equipment.
- Shut down during breaks or overnight.
- Fire watch to remain in effect ____ minutes after completion of hot work.

• _____
• _____

ATTENDANT(S): _____, _____

ENTRANT(S): _____, _____

ENTRY SUPERVISOR SIGNATURE: _____ **DATE** _____

PERMIT CANCELED: _____

Appendix 4. Atmospheric Only PRCS

**CONFINED SPACE PERMIT FOR SPACES WITH ONLY ATMOSPHERIC
HAZARDS THAT CAN BE CONTROLLED BY FORCED-AIR VENTILATION**

THE FOLLOWING PROCEDURES HAVE BEEN DONE FOR

(permit space identification)

- a. The cover, if any, was checked for heat and physical deformation, and removed safely. b. If necessary, a temporary barrier was provided for times when the entrance cover was removed.
- c. Before entrance, the internal atmosphere was tested with _____ for oxygen content.
- d. Before entrance, the internal atmosphere was tested with _____ for flammable gases and vapors.
- e. Before entry, the internal atmosphere was tested with the listed instruments for the listed toxic air contaminants:

INSTRUMENT (make/model/serial number)	AIR CONTAMINANT
_____	_____
_____	_____
_____	_____

- f. Continuous forced-air ventilation equipment was procured, tested (including the air supply), directed to the area(s) where an employee would be present within the space, and run for ____ minutes at a setting of ____ to clear the air in the space.

(Date)

(Signature)

CUSTOMIZING THE FORM

Before the form is printed, the official in charge of the permit space program:

1. May wish to identify all applicable spaces on the permit form itself. If only a few, the correct one could be circled by the certifier. If more than a few, they could be listed as a note at the bottom or on back of the permit.
2. Should fill in the blanks in items c. and d. Blanks must specify.